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Takashi ISHIDA et al.	:	Group Art Unit 2627
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OPTICAL DISC, OPTICAL DISC	:	
RECORDING APPARATUS, AND	:	
OPTICAL DISC RECORDING METHOD	:	Mail Stop:

VERIFICATION

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Sir:

I, Nobuo IIDA, of AOYAMA & PARTNERS, located at IMP Building, 1-3-7, Shiromi, Chuo-ku, Osaka 540-0001 Japan, declare and say:

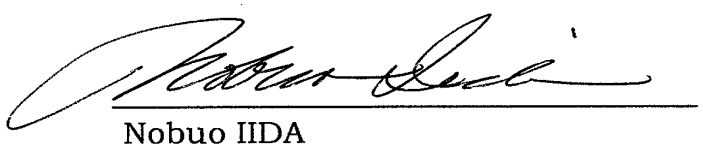
that, I am thoroughly conversant in both the Japanese and English languages; and

that I am presently engaged as a translator in these languages;

that the attached document represents a true and accurate English translation of the Japanese Priority Application No. 2002-310094 filed October 24, 2002.

I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signed this 16th day of January , 2009.



Nobuo IIDA

PATENT OFFICE
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This is to certify that the annexed is a true copy of the following application as filed with this Office.

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[Document name] Specification

[Title of the invention] Optical Disc

[What is claimed is:]

[Claim 1]

An optical disc being provided with a data recording area for recording data, and drive information area for recording drive specific information, wherein said drive information including a plurality of drive specific information and said a plurality of drive specific information are arranged sequentially in accordance with a time when said information recording medium has the information recorded thereto.

[Claim 2]

An optical disc being provided with a plurality of recording layers each having recording layer read by a read beam incident thereto from the same side of the disc and being characterized by that a drive information area for recording drive information is provided on at least one of said plurality of layers, and an unrecorded blank area is provided in the other recording layers at the same radial position as the drive information area.

[Claim 3]

An optical disc having a data recording area for recording data and a drive information area for recording drive specific information and disc specific information, wherein said drive information includes a plurality of drive specific information which are arranged in a sequence of time when said information recording medium carries out the recording.

[Detailed description of the invention]

[0001]

[Application field of the invention]

The present invention relates to an optical disc having a drive information area for recording a plurality of recording and playback conditions and other drive information.

[0002]

[Prior art]

It has been a greatly important problem to assure a reliability of an optical disc in view of a recent progress in a high recording density and a large storage capacity of an optical disc. To assure this reliability, optical disc drives use a learning process to determine the recording and playback conditions of the disc.

[0003]

This learning process is taught, for example, in Japanese Unexamined Patent Appl. Pub. 2001-338422.

[0004]

[Problem to be solved by the invention]

These recording and playback conditions depend greatly upon the characteristics of the optical disc and the characteristics of the optical disc drive. As a result, the learning process used to determine the recording and playback conditions must be executed every time the optical disc drive is started after an optical disc is loaded, and whenever there is a change in either optical disc or optical disc drive characteristics due to such factors as a change in temperature.

[0005]

In a more recent year, further advances in optical disc recording density and storage capacity have made it necessary to determine the recording and playback conditions even more precisely. However, it is necessary to determine the recording and playback conditions more precisely by means of this learning process. As a result, the optical disc drive spends more time waiting for recording or playback to start.

[0006]

In view of the problem mentioned above, an object of the present invention is to provide an optical disc capable of shortening a time to execute a learning process for obtaining recording and playback conditions

[0007]

[Means for solving the problem]

In order to solve the problem mentioned above, an optical disc according to the present invention is provided with a data recording area for recording data and a drive information area for recording drive information. The drive information contains plural conditions for recording and playback. The plural conditions for recording and playback arranged in a sequence of time when the conditions are recorded to an information-recording medium. This can achieve the object mentioned above.

[0008]

A further optical disc according to the present invention has a plurality of recording layers with each recording layer read by a read beam incident thereto from the same side of the disc. A drive information area for recording drive information is provided on at least one of said plurality of layers, and an unrecorded blank area is provided in the other recording layers at the same radial position as the drive information area.

[0009]

[Constitution of the invention]

A data-recording medium according to the present invention has a drive information area for recording drive-specific information such as recording and playback conditions. A data recording and playback apparatus acquires the recording and playback conditions through a learning process, and records the recording and playback conditions to the drive information area of the data recording medium. The recording and playback conditions recorded to the drive information area of the data recording medium are read and used to acquire new recording and playback conditions the next time the learning process is executed.

[0010]

These recording and playback conditions are the operating conditions used by the optical disc drive when the optical disc drive records information to an optical disc or reproduces recorded information from the optical disc.

[0011]

The recording and playback conditions also include at least one of the following: pulse conditions relating to the laser pulse emitted to the optical disc, servo conditions controlling servo operation during recording and playback, and playback signal processing conditions for processing the playback signal.

[0012]

The pulse conditions include, for example, the power of the laser pulse emitted to the optical disc during recording, or the laser pulse conditions for forming marks (the smallest unit of information) on the optical disc. When marks are formed on the optical disc by emitting a plurality of pulses to the optical disc from the leading edge to the trailing edge of the mark, the pulse conditions include at least the output timing and length of the first pulse, and the pulse power of the laser beam in this first pulse. In other case, a mark length and a space length positioned after or before the mark determine this.

[0013]

The recording and playback conditions could alternatively be the setting values of various circuits contained in the data recording and playback apparatus, or codes denoting those setting value.

[0014]

Thus reusing the recording and playback conditions recorded in the drive information area of the data recording medium simplifies the learning process. As a result, it is possible to reduce a time for completing the learning process, thereby causing the data recording and playback apparatus to reduce a time waiting before recording or playback.

[0015]

Preferred embodiments of the present invention are described in detail next below with reference to the accompanying figures.

[0016]

(Embodiment 1)

Fig. 1 shows the arrangement of a data recording medium 101 according to a first embodiment of the present invention.

[0017]

This data recording medium 101 is an optical disc having a plurality of concentric tracks 102. Alternatively, a single spiral track 102 or a plurality of spiral tracks 102 could be formed to the optical disc 101.

[0018]

The track area of the optical disc 101 includes a lead-in area 103, data recording area 104, and lead-out area 105.

[0019]

Parameters required to access the optical disc 101 are recorded in the lead-in area 103. The lead-in area 103 is formed at the inside circumference portion of the optical disc 101.

[0020]

The lead-out area 105 could also be used to record parameters required to access the optical disc 101. The lead-out area 105 is located at the outside circumference portion of the optical disc 101.

[0021]

Data is recorded and reproduced in the data recording area 104.

[0022]

Fig. 2 shows the logic structure of the lead-in area 103, data recording area 104, and lead-out area 105 on the optical disc 101 shown in Fig. 1.

[0023]

The lead-in area 201 includes a prerecorded area 204 and a recordable data recording area 205 for recording data. The prerecorded area 204 stores optical disc 101 identification data, for example, recorded in a wobble track, embossed pits, or wobbled embossed pits.

[0024]

The prerecorded area 204 includes a protected zone 208 as a buffer, and a control data zone 209. The control data zone 209 stores at least one of the following as optical disc 101 identification information: disc type, disc capacity, disc structure, channel bit, data zone address information, data rate, maximum playback power, recording power information, recording pulse position information, and disc-specific information.

[0025]

If the track pitch differs in the prerecorded area 204 and data recording area 205, the protected zone 210 can be used as a track pitch transition area. The data recording area 205 includes a protected zone 210, a reserved zone 211 enabling future development, a test zone 212 used for testing the optical disc 101, a buffer zone 213, a drive information zone 214 used for storing information such as the optical disc 101 characteristics, and a buffer zone 215.

[0026]

The data recording area 202 includes a data recording area 206 for recording user data, for example. The data recording area 206 includes a user data recording zone 216.

[0027]

The lead-out area 203 includes a recordable data recording area 207 for recording data. The data recording area 207 includes a buffer zone 217, a reserved zone 218 enabling future development, a buffer zone 219, and a protected zone 220 where data is not recorded.

[0028]

The drive information zone 214 is segmented into 2048 ECC blocks (clusters), for example. The ECC blocks are used for calculating an error correction code. The error correction code is calculated for each ECC block. Each ECC block is segmented into 32 sectors, for example.

[0029]

Fig. 3 shows an example of the ECC block structure. To achieve a high error correction capability and low redundancy in a high capacity optical disc, each ECC block is divided into 32 sectors. For simplicity, however, one ECC block is divided into only 4 sectors in the example shown in Fig. 3.

[0030]

As shown in Fig. 3, each ECC block includes 172 bytes x 48 rows of Main Data, Parity of Inner Code PI acquired by calculating the error correction code for each row of Main Data, and Parity of Outer Code PO acquired by calculating the error correction code for each vertical column of Main Data.

[0031]

Error correction codes including inner code parity and outer code parity are generally called product codes. A product code affords strong error correction of both random errors and burst errors (errors that are concentrated locally), such as where there is both random error and a burst error across two rows due to a scratch. Most such burst errors are 2-byte outer code errors and can be corrected. In a column where there are many random errors, however, correction using the outer code is not possible and errors remain, but these remaining errors can usually be corrected using the inner code. Even if inner code correction leaves some errors, applying outer code correction again can further reduce these errors. Redundant parity is suppressed and good error correction is assured by using this type of product code in DVD media. In other words, user data capacity can be increased according to the decrease in redundant parity data.

[0032]

As shown in Fig. 3, the Parity of Outer Code PO for the ECC block is evenly distributed one row per sector. As a result, one sector thus comprises 182 bytes x 13 rows of data.

[0033]

It is supposed that the optical disc drive is instructed to record or play an optical disc 101 loaded in the optical disc drive by sector unit. Then, the optical disc drive reads the ECC block containing the specified sector from the optical disc 101, applies error correction, and records only the data corresponding to the specified sector to the optical disc 101. It is supposed that the optical disc drive is instructed to record an optical disc 101 loaded in the optical disc drive by sector unit, the optical disc drive reads the ECC block containing the specified sector from the optical disc 101, applies error correction, replaces the data from the specified sector with the data to be recorded, recalculates the ECC and adds the new ECC to the data to be recorded, and then records the ECC block containing the specified sector to the optical disc 101.

[0034]

A "cluster" as used below means an ECC block as described above.

[0035]

Fig. 4 shows the structure of the drive information zone 214 shown in Fig. 2.

[0036]

The drive information zone 214 contains a plurality of clusters 401a, such as 2048 clusters 401a. These clusters 401a are arranged sequentially from cluster #1 at the inside circumference side to cluster #2, ... cluster #2048 at the outside circumference side. The drive information at one time is recorded by using one cluster. The first recording uses the cluster #1 and the second recording uses the cluster #2 sequentially from the inner circumference. Accordingly, after recoding k-times, the recording completed in the cluster #1 to the cluster #k. As a result, the newest information is stored to the cluster #k.

[0037]

The cluster 401a contains a plurality of drive specified information (recording and playback conditions, etc.) Each of a plurality of drive specified information 401b defines the operation conditions for an optical disc when the optical disc capable of mounting the optical disc 101 records and playbacks the data. Among a plurality of drive specific information 401b, the optical disc apparatus can define the drive specific information 401b more then one more than one.

[0038]

Referring to Fig. 4, the value following the symbol # is conveniently added in order to show a time sequence of the drive specific information 401b and is not included in the content of the drive specific information 401b. Note that the n is an integer larger than 0. In an example shown in Fig. 4, the cluster 401 a contains 32 drive specific information 401b. Each of the 32 drive specific information 401b is recorded to the inside of one sector.

[0039]

The drive-specific information includes a manufacturer identifier 402 for identifying a maker manufacturing the optical disc apparatus, auxiliary information 403, a drive identifier 404 such as a serial number for identifying the optical apparatus manufactured at the maker, and a data storage area 405 for storing the recoding and playback conditions

[0040]

Because the recording and playback conditions are stored to the data storage area 405, the drive-specific information is also referred to herein as the recording and playback conditions. It will be obvious that the information stored to the data storage area 405 could be information other than the recording and playback conditions.

[0041]

The recording and playback conditions of 32 items 401b are arranged in a sequence of time when the conditions are written to the optical disc 10. For example, the 32 items of the recording and playback conditions 401b are arranged in a order of

a new time to a old time. In this case, the cluster #k holds, at the head, the recording and playback condition #(n + 31) recorded most recently to the optical disc 101 among the 32 items of the recording and playback conditions 41b. The cluster #k holds, at the tail, the recording and playback condition #n recorded oldest to the optical disc 101 among the 32 items of the recording and playback conditions 401b.

[0042]

The recording and playback conditions 401b obtained through the new learning process are recorded to the head of the cluster #k. As a result, drive information area 502 is always assured of containing up to 32 recording and playback conditions entries including the results of the most recent learning process.

[0043]

The drive information zone 214 contains N ECC blocks (clusters). Each of the N ECC blocks (clusters) contains a plurality of sectors. Each of the plural recording and playback conditions 401b contained in each cluster 401a is recorded to a single corresponding sector. N is any positive integer value or 1 or more.

[0044]

The following description is directed to the renewal method of the drive specific information area 401 with reference to Fig. 5.

[0045]

Fig. 5 is to show a comparison between the structures of the drive specific information area 401 before the renewal and the drive specific information area 401 after the renewal. The renewal process of the drive specific information area 401is carried out, for example, at a time when an optical disc 101 is loaded to an optical disc apparatus.

[0046]

Referring to Fig. 5, the value following the symbol # is attached conveniently in order to show the time sequence of the recording and playback conditions 401b but is

not included in the content of the recording and playback condition 401b. Note that n is an integer more than 0.

[0047]

Note that the drive specific information area 401 has completed the recording of cluster #0 to the cluster #k.

[0048]

The cluster #k contains areas having the number 0 to 31 assigned thereto. The cluster #k includes 32 items of the recording and playback conditions 401b. The 32 items of the recording and playback conditions 401b are written to an area having a number 0 to 31 assigned thereto in a time sequence from the time when the new drive information is recorded to the drive information area 401 to the time when the old drive information is recorded to the drive information area 401 to the time. That is, the recording and playback condition 401b recorded most recently to the optical disc 101 among the 32 items of the recording and playback conditions 401b is written to the area having cluster number #0 assigned thereto, which is a head of the cluster completing the recording in the drive information area 401.

[0049]

The following description is directed to a method of updating the content of the new recording and playback conditions.

[0050]

The drive information area 401 is updated in the following way: The content of the recording and playback conditions 401b is written to an area-A having the cluster number 1 to 31 of the drive information area 401 assigned thereto. The drive information area 401 contains an area-B having the assigned number 1 to 31 of the next cluster #k+1 not yet recoded. The content of the recording and playback conditions subjected to a new learning process with an optical disc apparatus is rewritten to an area-C having the assigned number of the cluster #k+1 in the drive information area 401.

[0051]

Updating the drive information area 401 thus assures that the most recently recorded cluster #(k+1) in the drive information area 401 always contains the 32 newest recording and playback conditions 401b, and by reading this cluster first, the learning time can be shortened at a case of finding the recording and playback conditions that can be used.

[0052]

By thus structuring the drive information area 401 so that the so that data is updated by appending to unrecorded areas of the disc, the method of the present invention is not limited to use with rewritable optical disc media, and can also be used with write-once optical disc media.

[0053]

(Embodiment 2)

Fig. 6 shows the structure of a single-side, two-layer optical disc according to a second embodiment of the present invention.

[0054]

As shown in Fig. 6, this optical disc has a first substrate 601, first recording layer 602, a space layer 603 of an adhesive resin, for example, a second recording layer 604, and a second substrate 605.

[0055]

The laser beam is emitted from the second substrate 605 side of the disc shown in Fig. 6 to read and write data to the first recording layer 602 and second recording layer 604.

[0056]

A single or multiple spiral tracks could be formed on the first recording layer 602 and second recording layer 604.

[0057]

Fig. 7 shows the logic structure of a two-layer optical disc according to this embodiment of the invention.

[0058]

The prerecorded area 701a of the first recording layer stores, for example, identification data for the two-layer optical disc recorded in a wobble track, embossed pits, or wobbled embossed pits.

[0059]

The prerecorded area 701a includes a protected zone 703a as a buffer, and a control data zone 704a. The control data zone 704a stores at least one of the following as optical disc identification information: disc type, disc capacity, disc structure, channel bit, data zone address information, data rate, maximum playback power, recording power information, recording pulse position information, and disc-specific information.

[0060]

The information recorded in the control data zone 704a on the first recording layer could be information relating only to the first recording layer, or information relating to the first recording layer and information relating to the second recording layer.

[0061]

The prerecorded area 701b on the second recording layer is located at the same radial position as the prerecorded area 701a of the first recording layer.

[0062]

This prerecorded area 701b also includes a protected zone 703b as a buffer, and a control data zone 704b. The control data zone 704b stores at least one of the following as optical disc identification information: disc type, disc capacity, disc structure, channel bit, data zone address information, data rate, maximum playback power, recording power information, recording pulse position information, and disc-specific information.

[0063]

The information recorded in the control data zone 704b on the second recording layer could be information relating only to the first recording layer, or information relating to the first recording layer and information relating to the second recording layer. The control data zones 704a and 704b could store the same information.

[0064]

The data recording area 702a on the first recording layer includes a protected zone 705a in which data is not recorded, a reserved zone 706a enabling future development, a test zone 707a used for testing the optical disc, a buffer zone 708a, a drive information zone 709a used for storing information such as optical disc characteristics, a buffer zone 710a, a user data recording zone 711a for recording user data, a buffer zone 712a, a reserved zone 713a enabling future development, a buffer zone 714a, and a protected zone 715a in which data is not recorded.

[0065]

When the track pitch differs in the prerecorded area 701a and data recording area 702a, the protected zone 705a can be used as a track pitch transition area. The protected area 705b including no data is located at a radial position the same as the protected area 705a on the first recording layer.

[0066]

The data recording area 702b on the second recording layer contains the test area 707b for use in inspecting the optical disc. The test area 707b is located at a radial position the same as that of the reserve area on the first recording layer or is located in a way to make the inside circumference radius of both areas.

[0067]

The data recording area 702b also includes a reserved zone 706b for future developments. This reserved zone 706b is located at the same radial position as the

same as that of the test area 707a on the first recording layer or in a way to make the outside circumference radius of both areas.

[0068]

The data recording area 702b on the second recording layer also includes a buffer zone 708b, which is located at the same radial position as the buffer zone 708a on the first recording layer.

[0069]

The data recording area 702b on the second recording layer also includes a reserved zone 709b to which data is not recorded. This reserved zone 709b is located at the same radial position the same as the drive information zone 709a on the first recording layer.

[0070]

The data recording area 702b on the second recording layer also includes a buffer zone 710b, a user data recording zone 711b for recording user data, another buffer zone 712b, another reserved zone 713b enabling future developments, a buffer zone 714b, and a protected zone 715b to which data is not recorded. Each of these zones is located at the same radial position the same as the corresponding buffer zone 710a, user data recording zone 711a, buffer zone 712a, reserved zone 713a enabling future developments, buffer zone 714a, and protected zone 715a to which data is not recorded in the first recording layer.

[0071]

When the disc is spun along the tracks in order to carry out on recording and playback, the read/write direction of the tracks on the first recording layer is from inside to outside circumference as indicated by arrow 716a, and the read/write direction of the tracks on the second recording layer is from outside to inside circumference as indicated by arrow 716b.

[0072]

Because the control data zones are located at the same radial position in the first and second recording layers in accordance with this embodiment of the invention, the control data can be read from either recording layer, and the identification information can thus be acquired more quickly.

[0073]

Furthermore, a reserved zone 709b where data is not recorded is located on the second recording layer at the same radial position as the drive information zone 709a on the first recording layer. Accordingly, the drive information zone 709a can be read or written through a second recording layer that is always in the same state (that is, blank in this embodiment). As a result, the drive information can be read and written consistently and stably.

[0074]

Yet further, because a reserved zone where data is not recorded is disposed at the same radial position as at least part of the test zone, disc testing can be conducted under consistently stable conditions through another layer that is always in the same state (that is, blank in this embodiment).

In addition, it will be obvious that the structure of drive information zone 709a in this embodiment of the invention could be structured as shown in Fig. 4 or Fig. 9.

[0075]

(Embodiment 3)

Fig. 6 shows the structure of a single-side, two-layer optical disc according to a third embodiment of the present invention.

[0076]

Referring to Fig. 6, a reference numeral 601 denotes a first substrate; a reference numeral 602 denotes a first recording layer; a reference numeral 603 denotes a space layer composed of an adhesive resin; a reference numeral 604 denotes a second recording layer; and a reference numeral 605 denotes a second recording layer.

[0077]

Referring to Fig, 6, data is recorded and reproduced to the first recording layer 60 and the second recording layer 604 through emission of laser light from the second substrate 605.

[0078]

It is possible to form a track in a spiral form on the first recording layer 602 and the second recording layer 604. Alternatively, plural tracks can be formed in a spiral form.

[0079]

Fig. 8 shows an area to be disposed in the two layer optical disc shown in Fig. 6/

[0080]

The prerecorded area 801a of the first recording layer stores, for example, identification data for the two-layer optical disc recorded in a wobble track, embossed pits, or wobbled embossed pits.

[0081]

The prerecorded area 801a includes a protected zone 803a as a buffer, and a control data zone 804a. The control data zone 804a stores at least one of the following as optical disc identification information: disc type, disc capacity, disc structure, channel bit, data zone address information, data rate, maximum playback power, recording power information, recording pulse position information, and disc-specific information.

[0082]

The information including the control data zone 804a on the first recording layer could be information relating only to the first recording layer, or information relating to the first recording layer and information relating to the second recording layer.

[0083]

The prerecorded area 801b on the second recording layer is located at the same radial position as the prerecorded area 801a of the first recording layer.

[0084]

This prerecorded area 801b also includes a protected zone 803b as a buffer, and a control data zone 804b. The control data zone 804b stores at least one of the following as optical disc identification information: disc type, disc capacity, disc structure, channel bit, data zone address information, data rate, maximum playback power, recording power information, recording pulse position information, and disc-specific information.

[0085]

The information including the control data zone 804b on the second recording layer could be information relating only to the first recording layer, or information relating to the first recording layer and information relating to the second recording layer. The control data zones 804a and 804b could store the same information.

[0086]

The data recording area 802a on the first recording layer includes a protected zone 805a in which data is not recorded, a buffer zone 806a, a drive information zone 807a used for storing information such as optical disc characteristics, a buffer zone 808a, a test zone 809a used for testing the optical disc, a reserved zone 810a for future developments, a user data recording zone 811a for recording user data, a buffer zone 812a, a reserved zone 813a enabling future development, a buffer zone 814a, and a protected zone 815a in which data is not recorded.

[0087]

When the track pitch differs in the prerecorded area 801a and data recording area 802a, the protected zone 805a can be used as a track pitch transition area. The protected area 805b storing no data is disposed at the radial position the as that of the protected area 805a on the first recording layer.

[0088]

The data recording area 802b on the second recording layer likewise includes a protected zone 807b in which data is not recorded and is located at the radial position the same as that of the drive information area 807.

[0089]

The data recording area 802b of the second recording layer also includes a reserved zone 810b allowing for future developments. This reserved zone 810b is located at the same radial position as the test zone 809a on the first recording layer or at a radial position on the inside circumference side of the test zone 809a.

[0090]

The data recording area 802b on the second recording layer also includes a test zone 809b for use in testing the optical disc. This test zone 809b is located at the same radial position as the reserved area 810a on the first recording layer or at a radial position on the inside circumference side of the reserved area 810a.

[0091]

Further, the data recording area 802b on the second recording layer includes a user data recording zone 811b for recording user data, another buffer zone 812b, another reserved zone 813b enabling future developments, a buffer zone 814b, and a protected zone 815b to which data is not recorded. Each of these zones is located at the same radial position as the corresponding user data recording zone 811a, buffer zone 812a, reserved zone 813a enabling future developments, buffer zone 814a, and protected zone 815a to which data is not recorded in the first recording layer.

[0092]

When the disc is spun for reading and writing along the tracks, the read/write direction of the tracks on the first recording layer is from inside to outside circumference as indicated by arrow 816a, and the read/write direction of the tracks on the second recording layer is from outside to inside circumference as indicated by arrow 816b.

[0093]

Because the control data zones are located at the same radial position in the first and second recording layers in accordance with this embodiment of the invention, the control data can be read from either recording layer, and the identification information can thus be acquired more quickly.

[0094]

Furthermore, because a reserved zone 807b where data is not recorded is located on the second recording layer at the same radial position as the drive information zone 807a on the first recording layer, the drive information zone 807a can be read or written through a second recording layer that is always in the same state (that is, blank in this embodiment). As a result, the drive information can be read and written consistently and stably.

[0095]

Yet further, because a reserved zone where data is not recorded is disposed at the same radial position as at least part of the test zone with the structure according to the present invention, disc testing can be conducted under consistently stable conditions through another layer that is always in the same state (that is, blank in this embodiment).

It will be obvious that the structure of drive information zone 807a in this embodiment of the invention could be structured as shown in any of Fig. 4 or Fig. 9.

[0096]

(Embodiment 4)

Fig. 9 shows the structure of the drive information zone 214 shown in Fig. 2 according to a fourth embodiment of the present invention.

[0097]

A drive information area 901 includes a plurality of cluster 901a, for example, 2048 cluster 901a. The clusters are arranged in an order of cluster #0, cluster #1cluster 2047 form the inner side. The drive information of one time is recorded by

using one cluster. The first recording uses the cluster #0 and the second recording uses the cluster #2 in a way to use the cluster from the inside circumference. Accordingly, after the recording at k times, the cluster #0 to cluster #k have been already recorded. The newest information is recorded to the cluster #k.

[0098]

The cluster 901a includes plural drive specific information (such as recording and playback conditions) 901b and the disc specific information 901c. Each of the plural drive specific information 901b defines the operation condition of the optical apparatus when the optical disc apparatus capable of mounting the optical disc 101 records or playbacks data. Among the plural drive specific information 901b, drive specific information 901b more than one can define the optical disc apparatuses more than one.

[0099]

Referring to Fig. 9, the value following the symbol # is conveniently added in order to show a time sequence of the drive specific information 901b and is not included in the content of the drive specific information 901b. Note that the n is an integer larger than 0. In an example shown in Fig. 9, the cluster 901a contains 31 drive specific information 901b and 1 disc specific information 901c. Each of the 31 drive specific information 901b and 1 disc specific information 901c is recorded to the inside of one sector.

[0100]

The drive-specific information 901b includes a manufacturer identifier 902 for identifying a maker manufacturing the optical disc apparatus, auxiliary information 903, a drive identifier 904 such as a serial number for identifying the optical apparatus manufactured at the maker, and a data storage area 905 for storing the recoding and playback conditions.

[0101]

Since the recording and playback conditions are stored to the data storage area 905, the drive-specific information is also referred to herein as the recording and playback conditions. It will be obvious that the information stored to the data storage area 905 could be information other than the recording and playback conditions.

[0102]

The disc specific information 901c includes the final address for recording user data and the final address for the used test area and etc.

[0103]

The recording and playback conditions of 31 items 901b are arranged in a sequence of time when the conditions are written to the optical disc 10. For example, the 31 items of the recording and playback conditions 901b are arranged in a order of a new time to a old time. In this case, the cluster #k holds, at the head, the recording and playback condition #(n + 31) recorded most recently to the optical disc 101 among the 31 items of the recording and playback conditions 901b. The cluster #k holds, at the tail, the recording and playback condition #n recorded oldest to the optical disc 101 among the 31 items of the recording and playback conditions 901b.

[0104]

The recording and playback conditions 901b obtained through the new learning process are recorded to the head of the cluster #k. As a result, drive information area 901 is always assured of containing up to 31 recording and playback conditions entries including the results of the most recent learning process.

[0105]

The drive information zone 214 contains N ECC blocks (clusters). Each of the N ECC blocks (clusters) contains a plurality of sectors. Each of the plural recording and playback conditions 901b contained in each cluster 901a is recorded to a single corresponding sector. N is any positive integer value or 1 or more.

[0106]

The following description is directed to the renewal method of the drive specific information area 901 with reference to Fig. 10.

[0107]

Fig. 10 is to show a comparison between the structures of the drive specific information area 901 before the renewal and the drive specific information area 901 after the renewal. The renewal process of the drive specific information area 901 is carried out, for example, at a time when an optical disc 101 is loaded to an optical disc apparatus.

[0108]

Referring to Fig. 10, the value following the symbol # is attached conveniently in order to show the time sequence of the recording and playback conditions 901b but is not included in the content of the recording and playback condition 901b. Note that n is an integer more than 0.

[0109]

Note that the drive specific information area 901 has completed the recording of cluster #0 to the cluster #k.

[0110]

The cluster #k contains areas having the number 0 to 31 assigned thereto. The cluster #k includes 31 items of the recording and playback conditions 901b. The 31 items of the recording and playback conditions 901b are written to an area having a number 0 to 30 assigned thereto in a time sequence from the time when the new drive information is recorded to the drive information area 901 to the time when the old drive information is recorded to the drive information area 901 to the time. That is, the recording and playback condition 901b recorded most recently to the optical disc 101 among the 31 items of the recording and playback conditions 401b is written to the area having cluster number #0 assigned thereto, which is a head of the cluster completing the recording in the drive information area 901.

[0111]

The following description is directed to a method of updating the content of the new recording and playback conditions.

[0112]

The drive information area 901 is updated in the following way: The content of the recording and playback conditions 901b is written to an area-A having the cluster number 1 to 29 of the drive information area 901 assigned thereto. The drive information area 901 contains an area-B having the assigned number 1 to 30 of the next cluster #k+1 not yet recoded. The content of the recording and playback conditions subjected to a new learning process with an optical disc apparatus is rewritten to an area-C having the assigned number of the cluster #k+1 in the drive information area 901.

[0113]

When the disc specific information 901c is also updated, it is recorded to an area in which the new information is assigned with a number k+1 of a cluster #k+1.

[0114]

The following description is directed an updating method of the drive information area 901at a case of updating the disc specific information with reference to Fig. 11.

[0115]

Fig. 11 shows a comparison between the structure of the drive information area 901 before the updating and the structure of the drive information 901 after updating.

[0116]

The disc specific information 901c is updated at a case of recording newly the user data in an amount more than a given amount. It is supposed the given amount is selected in such a way that a number of clusters in the drive information 901 is N; the recording capacity of the user data area is S; and N is given to 2S/N. Then, even at a case of recording the total of the user data area, the updating times of the disc specific

information 901c is less than N/2. Accordingly, this case leaves the drive information area more than 1/2 and is preferable.

[0117]

Referring to Fig. 11, the value following the symbol # is attached conveniently in order to show the time sequence of the recording and playback conditions 901b but is not included in the content of the recording and playback condition 901b. Note that n is an integer more than 0.

[0118]

In the drive information area 901 before the update, the cluster # to cluster #k have been already recorded.

[0119]

The cluster #k contains areas having the number 0 to 31 assigned thereto. The cluster #k includes 31 items of the recording and playback conditions 901b. The 31 items of the recording and playback conditions 901b are written to an area having a number 0 to 30 assigned thereto in a time sequence from the time when the new drive information is recorded to the drive information area 901 to the time when the old drive information is recorded to the drive information area 901 to the time. That is, the recording and playback condition 901b recorded most recently to the optical disc 101 among the 31 items of the recording and playback conditions 401b is written to the area having cluster number #0 assigned thereto, which is a head of the cluster completing the recording in the drive information area 901 (adjust to the cluster having no recording).

[0120]

The following description is directed to a method of updating the content of the disc specific information.

[0121]

The drive information area 901 is updated in the following way: The content of the recording and playback conditions 901b is written to an area-A having the cluster

number 1 to 29 of the drive information area 901 assigned thereto. The drive information area 901 contains an area-B having the assigned number 1 to 30 of the next cluster #k+1 not yet recoded. The content of the new disc specific information #m+1 is rewritten to an area-C having the assigned number of the cluster #k+1 in the drive information area 901.

[0122]

The update of the drive information area 901 assures that in the drive information area, the cluster #k+1 recorded most recently includes always 31 items of recording and playback conditions 901b. Then, when a drive reads this part first, it is possible to shorten the learning time at a case of having a usable recording and playback conditions.

[0123]

As mentioned above, when the drive information area 901 is made in a structure capable of carrying out the information update by recording additionally to an area having no recoding, it is possible to use not only rewitable optical disc but also an optical disc capable of recording once (Write-once type).

This is advantageous.

[0124]

Further, it is possible to access more quickly to a recording area with no recorded data or to a new test area at a case of additional recording by recording a final address including a user data and a final address to a used test area.

[0125]

Furthermore, because both drive-specific information and disc-specific information are recorded in one cluster (ECC block), both the drive-specific information and disc-specific information can be updated by updating only one cluster. The drive-specific information can therefore be used efficiently with particularly noticeable benefit in write-once optical discs that can only be recorded once.

[0126]

[Effect of the invention]

In accordance with the optical disc of the present invention, a plurality of recording and playback conditions are arranged in a sequence of a time when the conditions are recorded to the optical disc. This assures that the drive information includes always the newest recording and playback condition.

[0127]

Furthermore, in a multilayer disc according to the present invention, the radial area of one layer overlapping the drive information area in another layer has no data recorded thereon. Accordingly, it is possible to assure that that the drive information can always be read under stable conditions.

[Brief description of the drawings]

Fig. 1 shows the layout of an optical disc 101 according to a first embodiment of the present invention;

Fig. 2 shows the logic structure of areas in the optical disc shown in Fig. 1;

Fig. 3 shows an example of an ECC block;

Fig. 4 shows the structure of the drive information area;

Fig. 5 shows structures of the drive information area after and before update;

Fig. 6 shows the structure of an optical disc with two recording layers;

Fig. 7 shows the logic structure of areas in an optical disc according to a second embodiment of the present invention;

Fig. 8 shows the logic structure of areas in an optical disc according to a third embodiment of the present invention;

Fig. 9 shows a structure of the drive information area;

Fig. 10 shows the structure of the drive information areas before and after update; and

Fig. 11 shows the structure of the drive information areas before and after update.

[Description of symbols]

101.....optical disc

102.....track

601.....first substrate

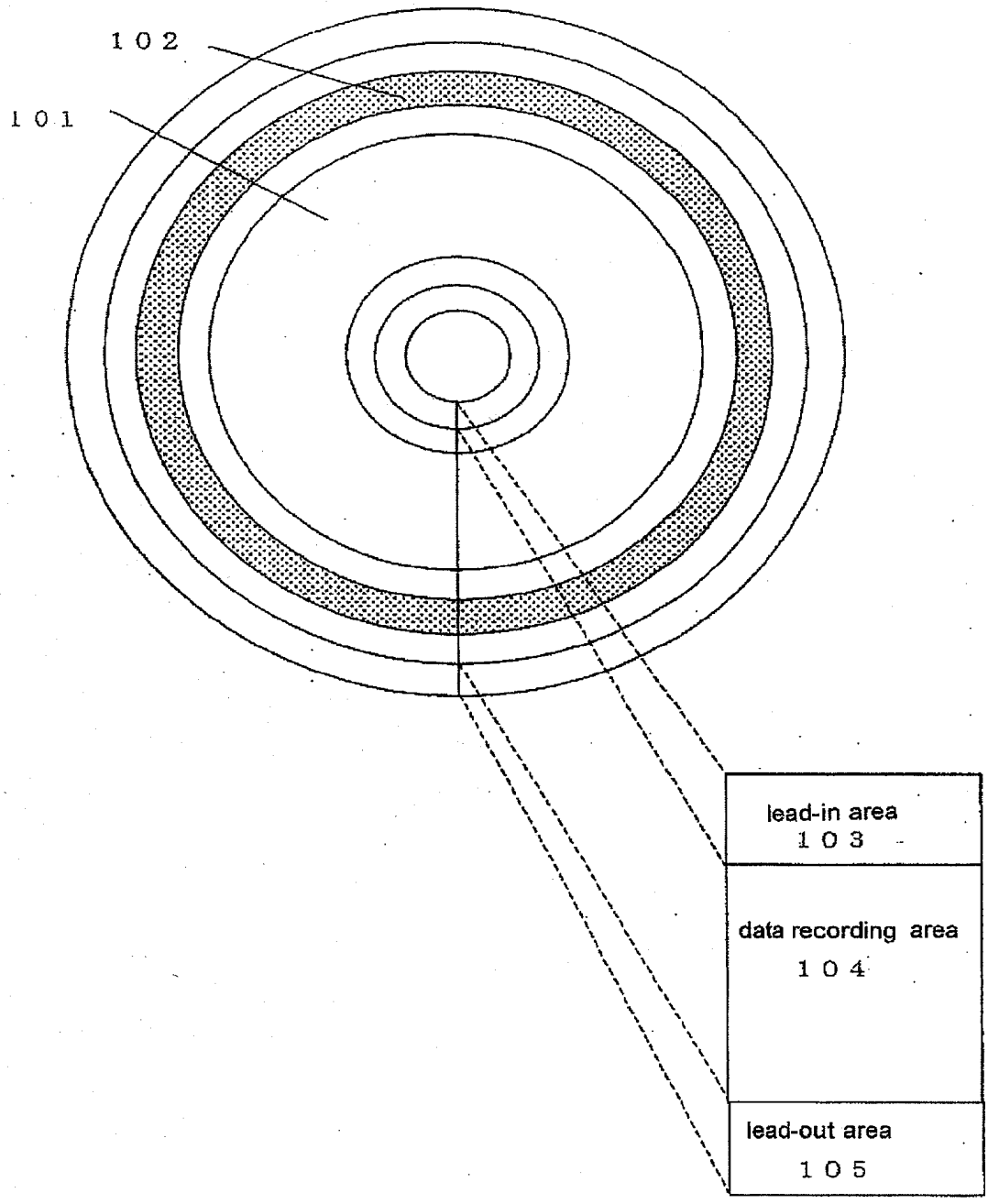
602.....first recording layer

603.....space layer

604.....second recording layer

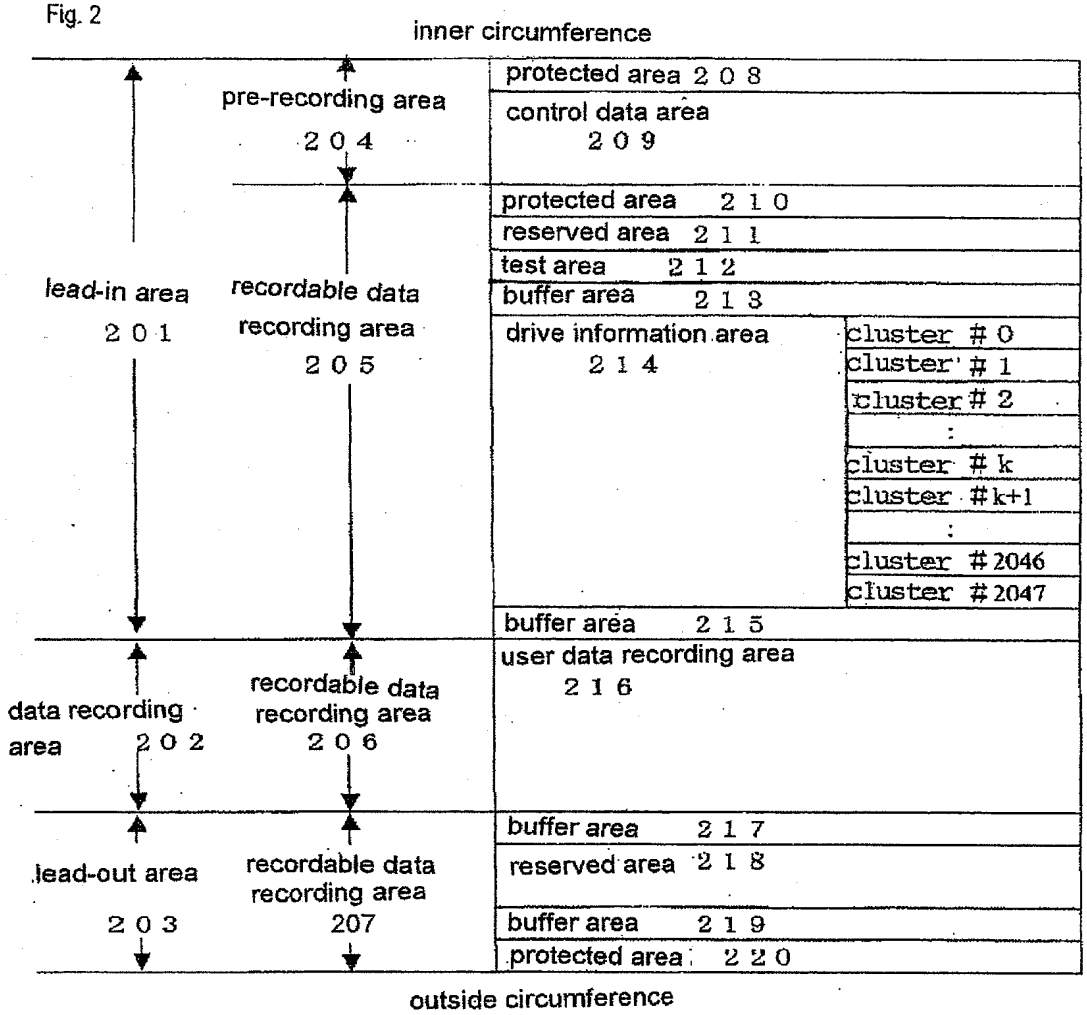
605.....second substrate

【書類名】　図面
Document name;　Drawings
【図１】
Fig. 1

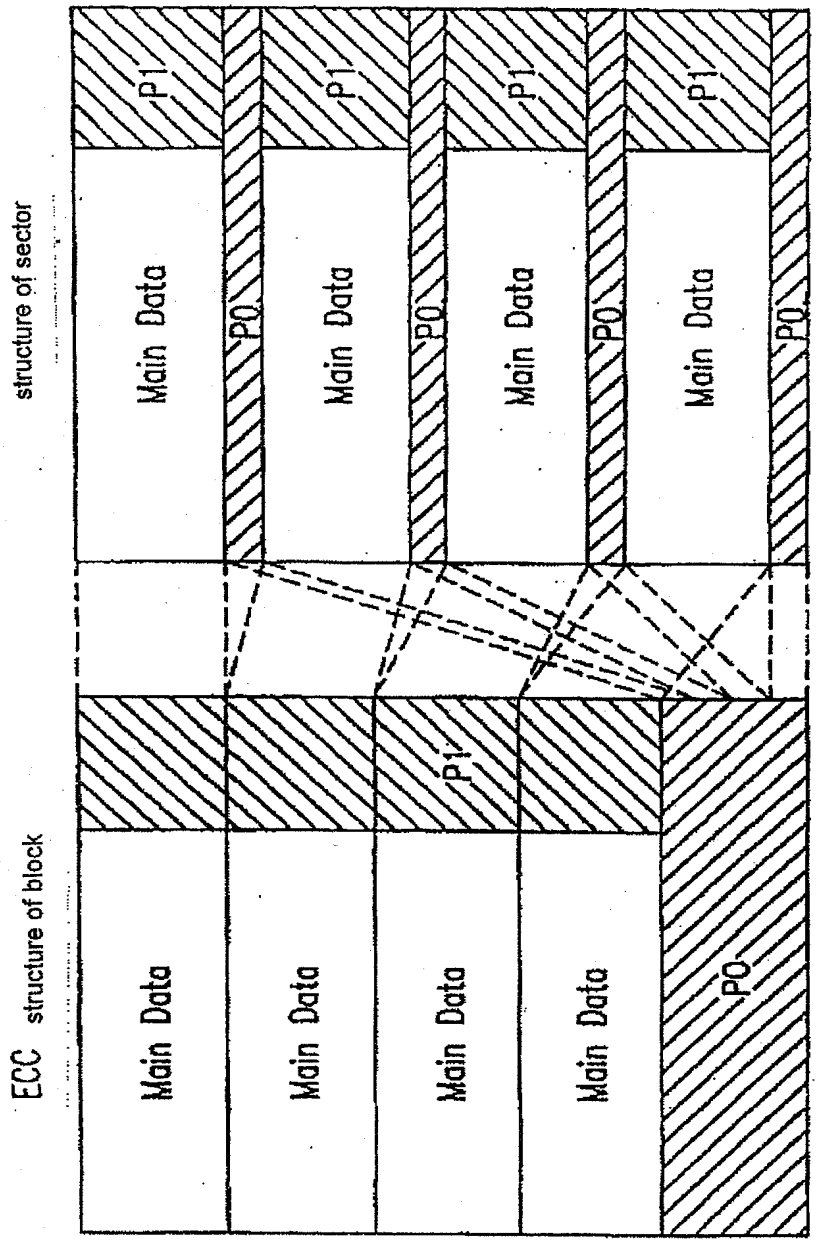


【図２】

Fig. 2

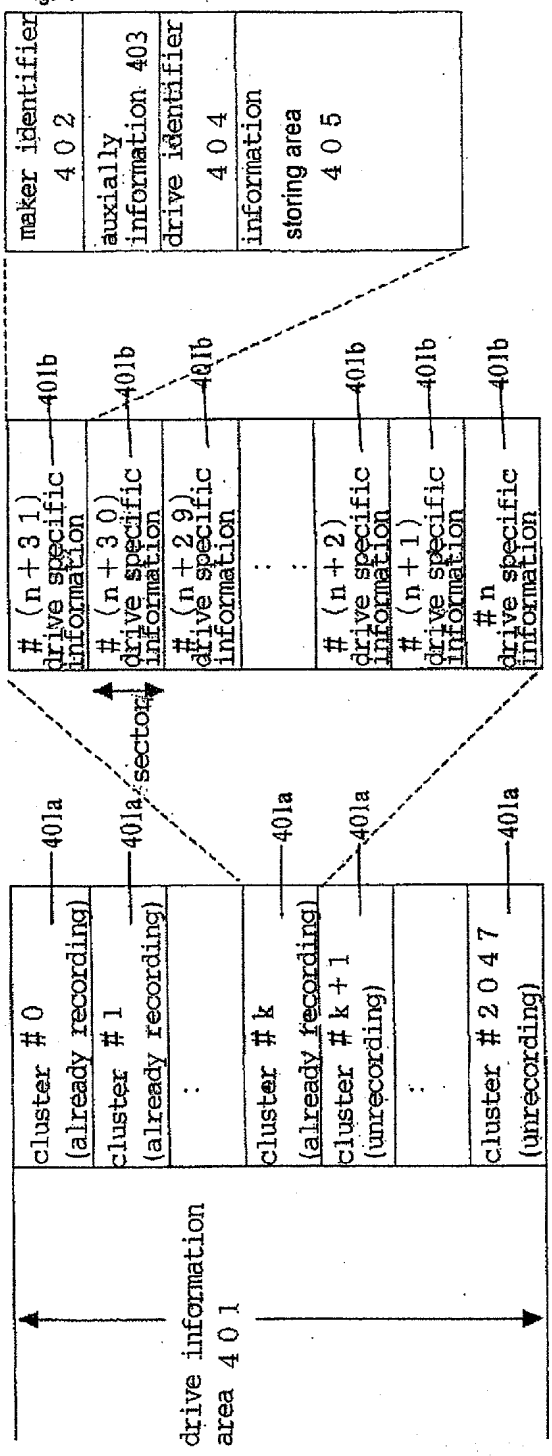

inner circumference
pre-recording area
２０４
lead-in area
２０１
recordable data recording area
２０５
data recording area
２０２
recordable data recording area
２０６
lead-out area
２０３
recordable data recording area
207
protected area ２０８
control data area
２０９
protected area ２１０
reserved area ２１１
test area ２１２
buffer area ２１３
drive information area
２１４
cluster #0
cluster #1
cluster #2
:
cluster #k
cluster #k+1
:
cluster #2046
cluster #2047
buffer area ２１５
user data recording area
２１６
buffer area ２１７
reserved area ２１８
buffer area ２１９
protected area ２２０
outside circumference

【図３】
Fig. 3


structure of sector
Main Data
P0
P1
ECC structure of block
Main Data
P0
P1

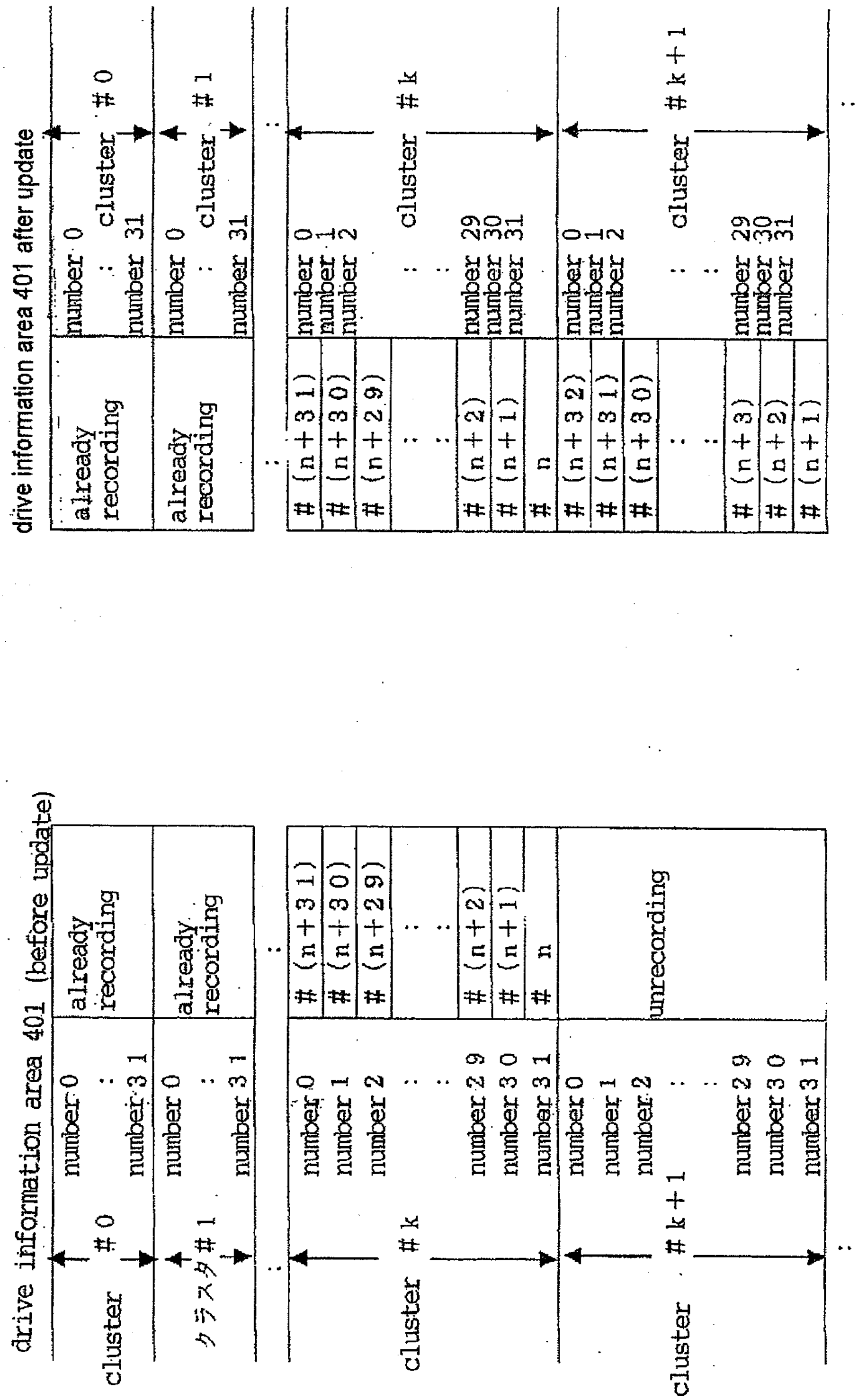
【図４】

Fig. 4

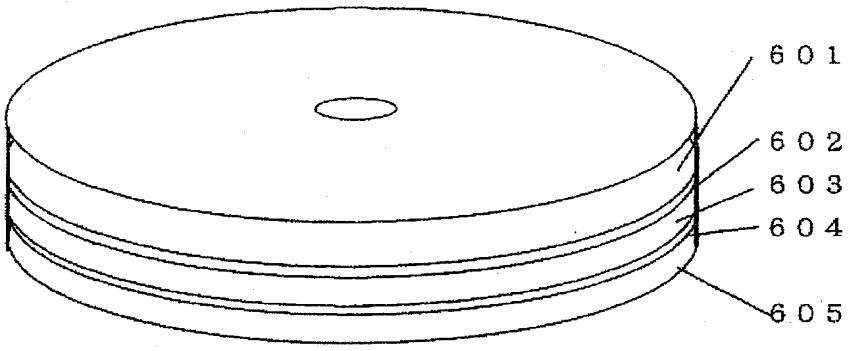

drive information area 401
cluster # 0 (already recording) 401a
cluster # 1 (already recording) 401a
cluster # k (already recording) 401a
cluster # k+1 (unrecording) 401a
cluster # 2047 (unrecording) 401a
sector
(n+31) drive specific information 401b
(n+30) drive specific information 401b
(n+29) drive specific information 401b
(n+2) drive specific information 401b
(n+1) drive specific information 401b
n drive specific information 401b
maker identifier 402
auxially information 403
drive identifier 404
information storing area 405

【図５】

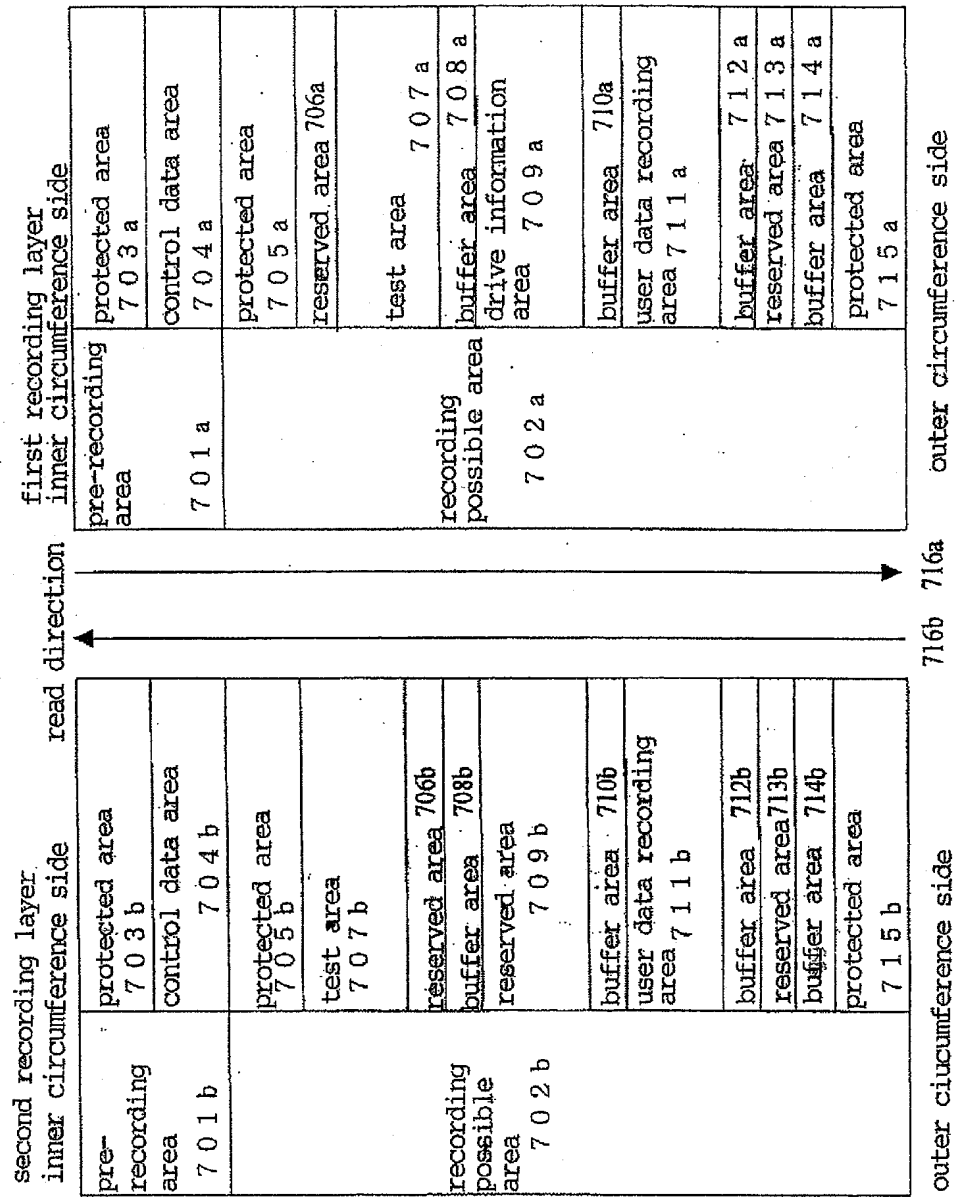
Fig. 5


drive information area 401 after update
already recording
number 0
number 31
cluster #0
cluster #1
cluster #k
cluster #k+1
drive information area 401 (before update)
クラスタ#1
unrecording

【図６】
Fig. 6

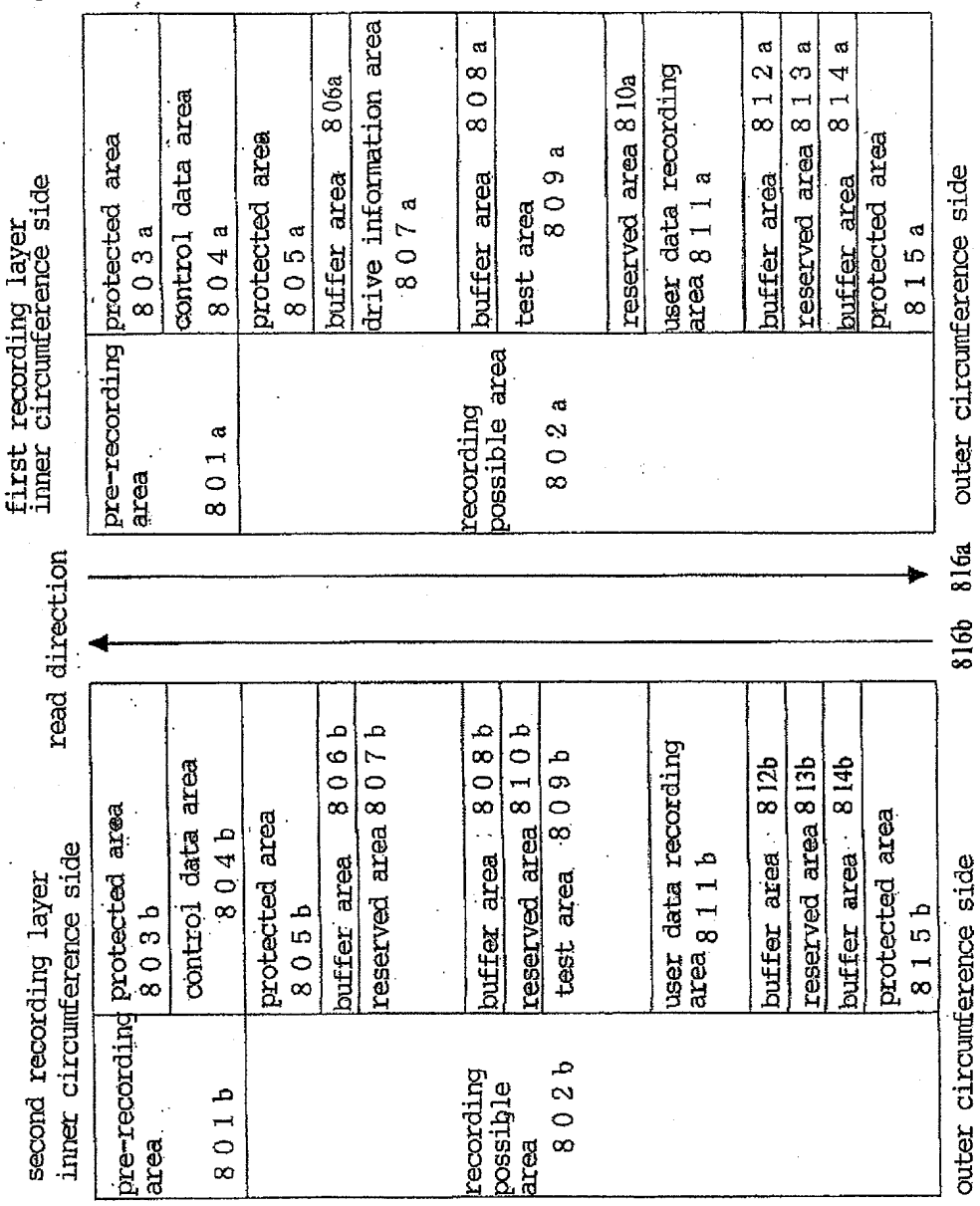


【図７】
Fig. 7


first recording layer
inner circumference side
pre-recording area
701a
protected area
703a
control data area
704a
protected area
705a
reserved area 706a
test area
707a
buffer area
708a
drive information area
709a
buffer area
710a
user data recording area
711a
buffer area
712a
reserved area
713a
buffer area
714a
protected area
715a
recording possible area
702a
read direction
second recording layer
inner circumference side
pre-recording area
701b
protected area
703b
control data area
704b
protected area
705b
test area
707b
reserved area
706b
buffer area
708b
reserved area
709b
buffer area
710b
user data recording area
711b
buffer area
712b
reserved area
713b
buffer area
714b
protected area
715b
recording possible area
702b
outer ciucumference side
716b
716a
outer circumference side

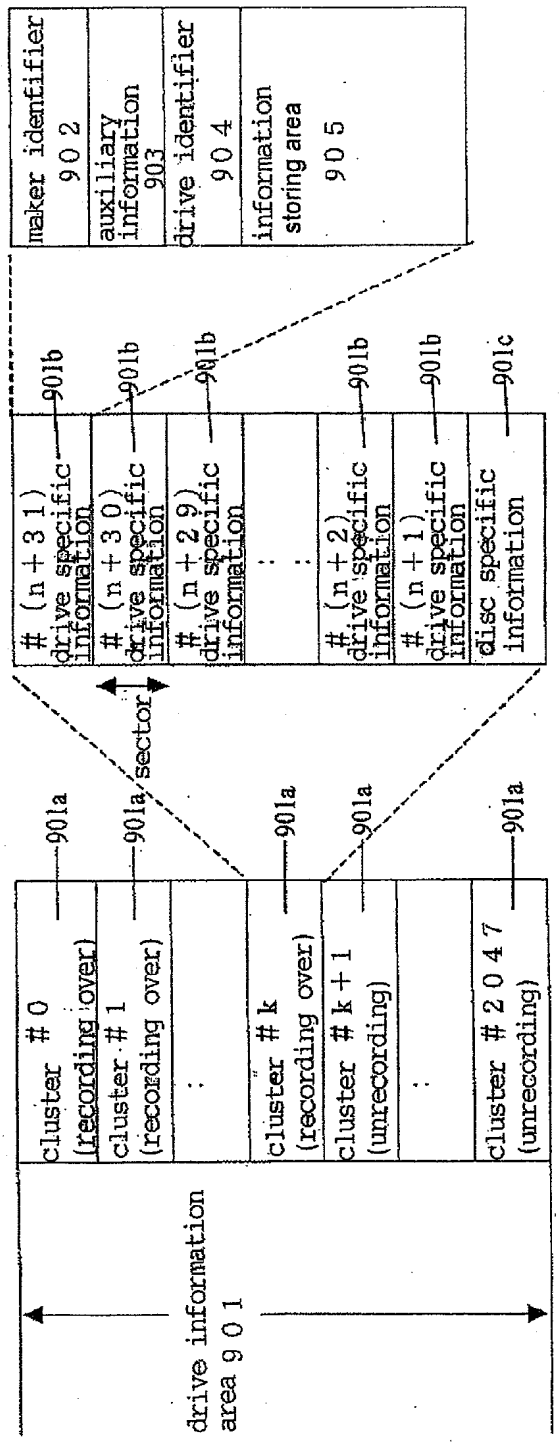
【図８】

Fig. 8


first recording layer
inner circumference side
pre-recording area 801a
protected area 803a
control data area 804a
protected area 805a
buffer area 806a
drive information area 807a
recording possible area 802a
buffer area 808a
test area 809a
reserved area 810a
user data recording area 811a
buffer area 812a
reserved area 813a
buffer area 814a
protected area 815a
outer circumference side
816a
read direction
816b
second recording layer
inner circumference side
pre-recording area 801b
protected area 803b
control data area 804b
protected area 805b
buffer area 806b
reserved area 807b
recording possible area 802b
buffer area 808b
reserved area 810b
test area 809b
user data recording area 811b
buffer area 812b
reserved area 813b
buffer area 814b
protected area 815b
outer circumference side

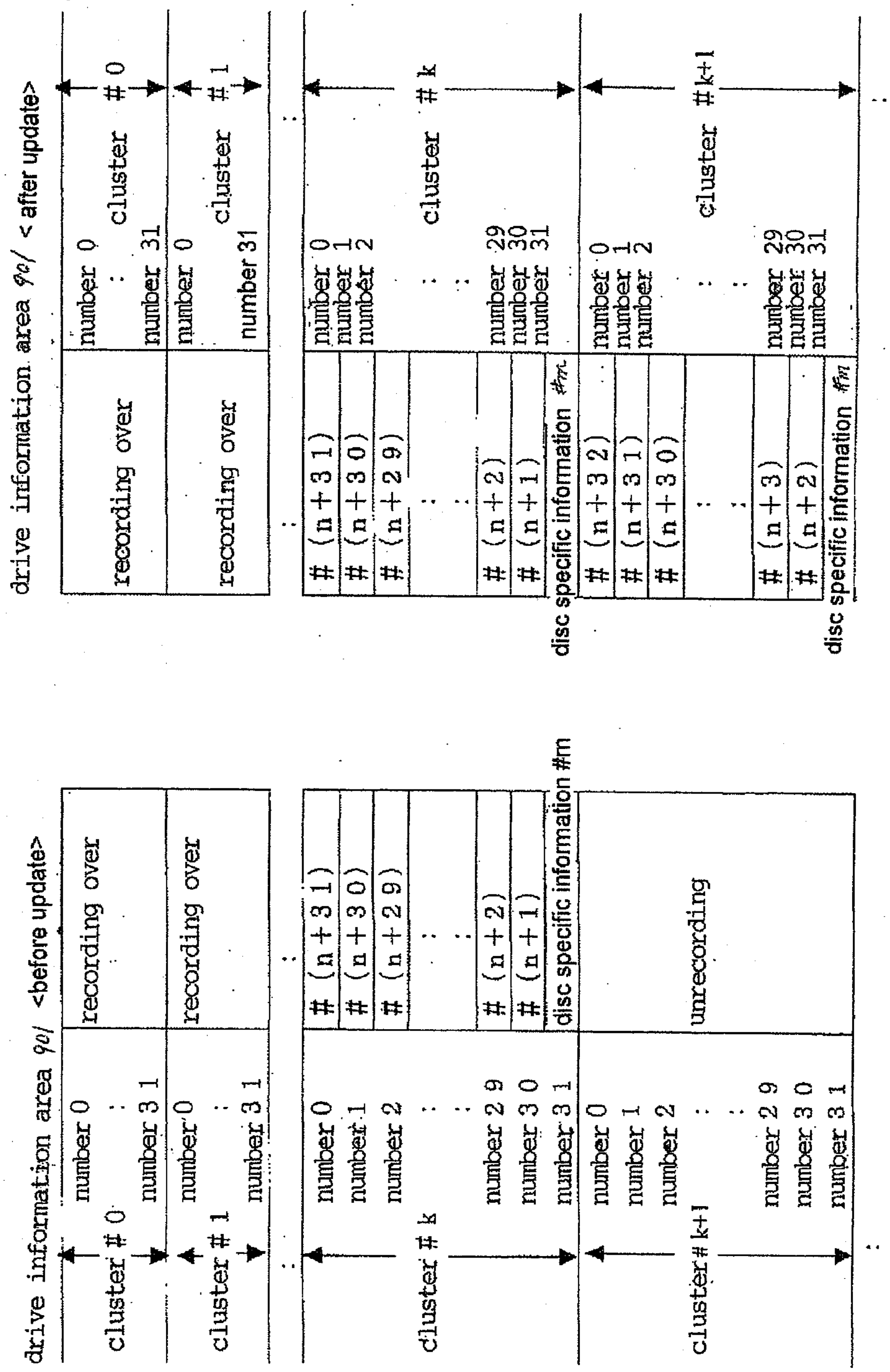
【図９】

Fig. 9

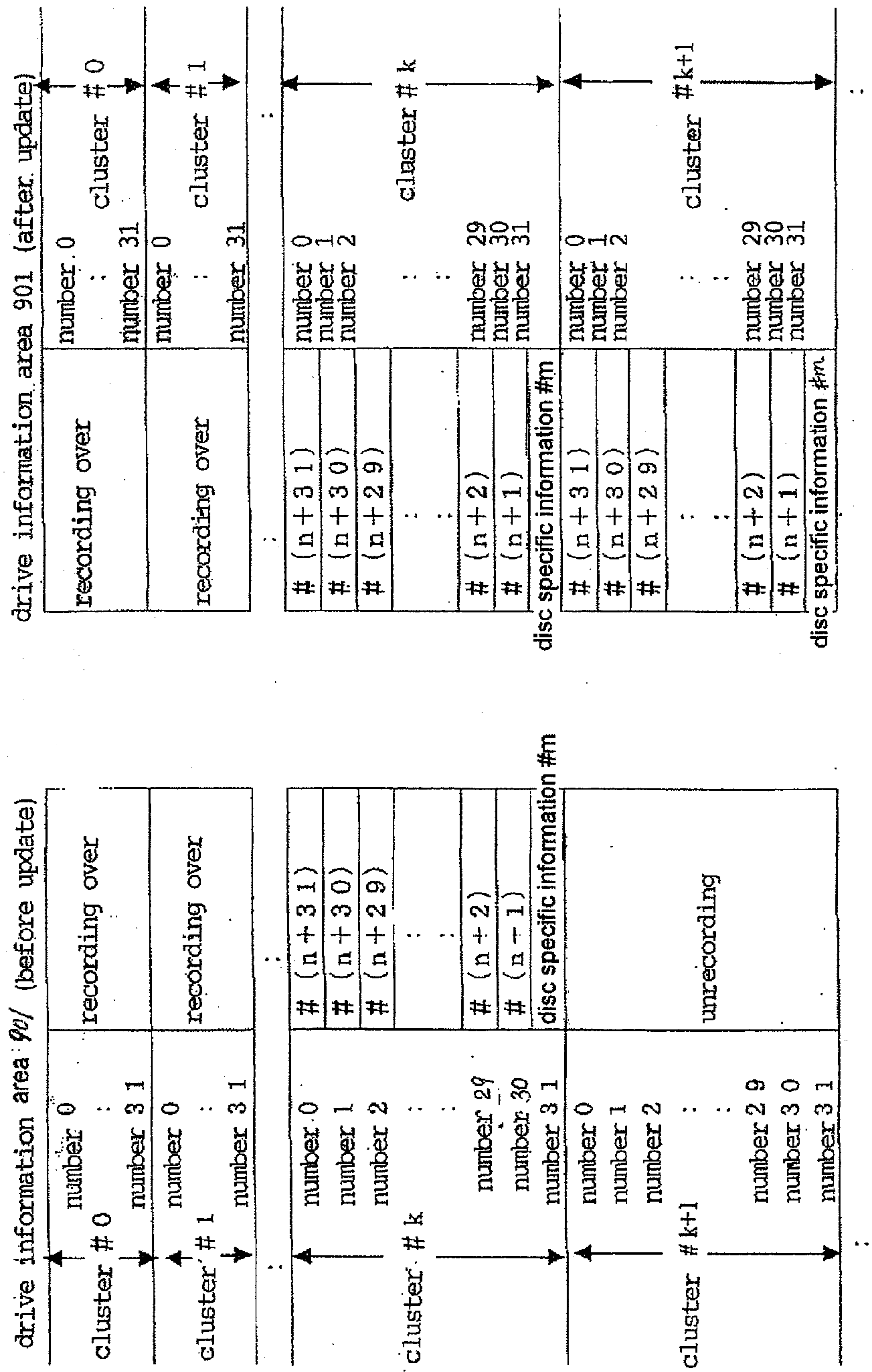

drive information area 901
cluster # 0 (recording over) 901a
cluster # 1 (recording over) 901a
cluster # k (recording over) 901a
cluster # k+1 (unrecording) 901a
cluster # 2047 (unrecording) 901a
sector
(n+31) drive specific information 901b
(n+30) drive specific information 901b
(n+29) drive specific information 901b
(n+2) drive specific information 901b
(n+1) drive specific information 901b
disc specific information 901c
maker identifier 902
auxiliary information 903
drive identifier 904
information storing area 905

【図１０】

Fig. 10


drive information area 901 < after update>
cluster #0
cluster #1
cluster #k
cluster #k+1
recording over
recording over
number 0
number 31
number 1
number 2
number 29
number 30
#(n+31)
#(n+30)
#(n+29)
#(n+2)
#(n+1)
#(n+32)
#(n+3)
disc specific information #m
drive information area 901 <before update>
cluster # 0
cluster # 1
cluster # k
cluster # k+1
unrecording

【図１１】
Fig. 11


drive information area 901 (after update)
recording over
number 0
number 31
cluster # 0
cluster # 1
(n+31)
(n+30)
(n+29)
(n+2)
(n+1)
disc specific information #m
number 1
number 2
number 29
number 30
cluster # k
cluster #k+1
drive information area 901 (before update)
(n−1)
unrecording

[Document name] Abstract

[Abstract]

[Problem]

A problem is to assure that the drive information is always updated in a way to include the recording and playback conditions showing the latest learning result.

[Means for solving the problem]

The data recording medium 101 has a data recording area 104 for recording data, and a drive information area 401 for recording drive information 401a. The drive information 401a includes a plurality of drive-specific information records 401b. Each of the plural drive-specific information records 401b defines the operating conditions of the data recording and playback apparatus when a data recording and playback apparatus that can load and access the data recording medium 101 reads or writes data. The plural drive-specific information records 401a are arranged chronologically according to when the information was recorded to the data recording medium 101.